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THE CRITICAL IONIZATION POTENTIALS OF URANIUM HEXAFLUORIDE
AND HYDROGEN FLUORIDE

by

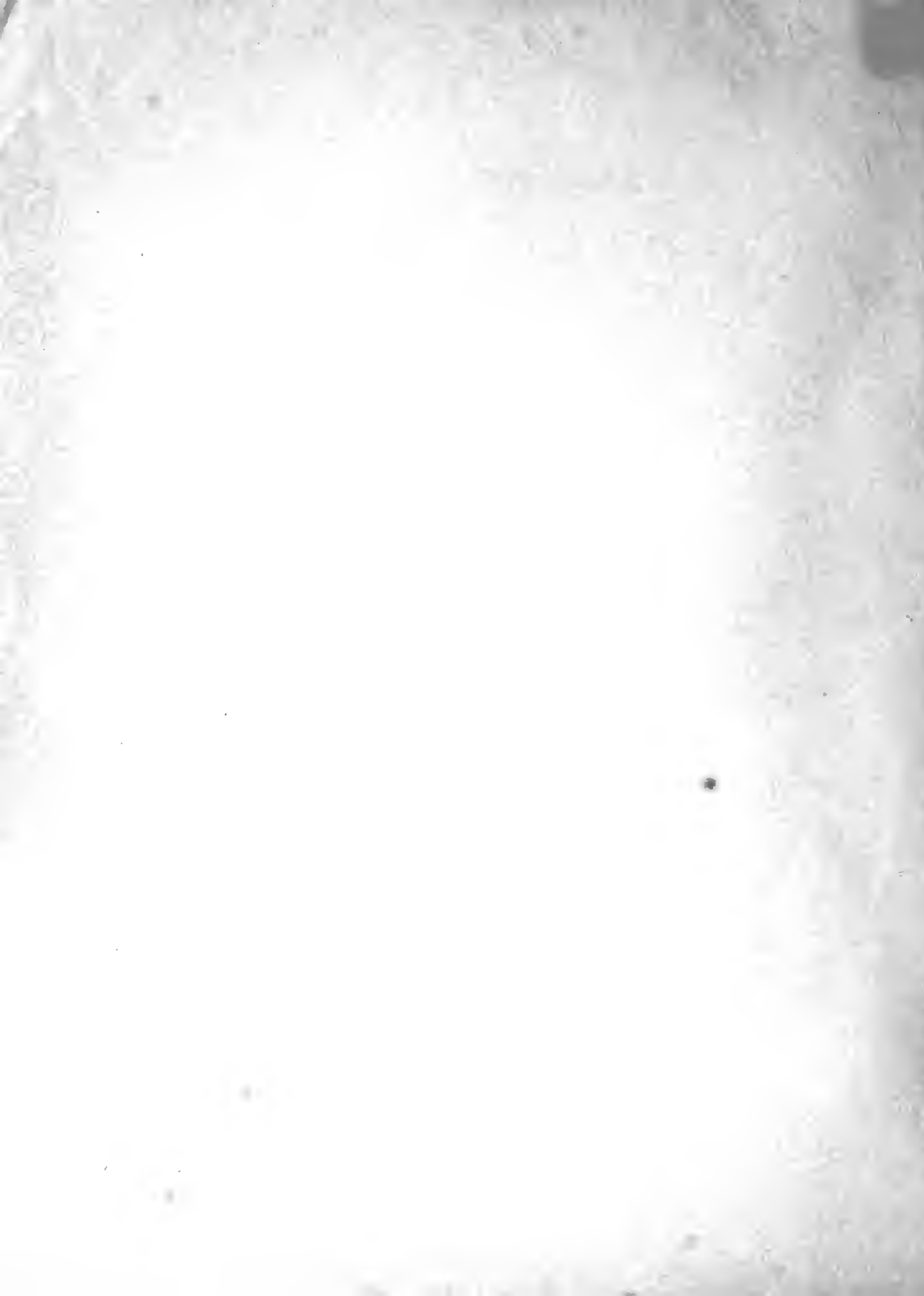
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THE CRITICAL IONIZATION POTENTIALS OF URANIUM HEXAFLUORIDE AND HYDROGEN FLUORIDE

By J. R. White and A. E. Cameron

The critical ionization potentials of uranium hexafluoride and of hydrogen fluoride were determined by using a VG1A ion gauge. Filament emission was held constant at such a value that the grid current was in a plateau region and the grid to filament potential varied. The onset of ionization was determined by plotting ion current as a function of applied voltage. Ions were collected on the plate by application of a small fixed potential, and secondary emission and space charge effects evaluated by measuring the ionization potential of mercury. The correction was determined, using the value of 10.4* volts for the first ionization potential of mercury, and was subtracted from the potential observed for uranium hexafluoride. Measurements were made with hydrogen fluoride to eliminate the possibility that the potential observed with uranium hexafluoride was due to hydrolysis products.

The measurements upon uranium hexafluoride were repeated in a 60° mass spectrometer of the Nier type, so that ions other than the UF_5^+ could be identified and measured. The ionizing case and the electron trap were operated at the same potential, so that the voltage drop from the filament to these elements was a measure of the ionization potential. The effect of space charge, thermal excitation and secondary emission in the ionizing region were evaluated by using mercury as reference gas. Filament emission was held constant at 1.4 ma, and no potentials except that between filament and ionizing case were varied after measurements upon mercury. Potentials were measured with a voltmeter which had been calibrated carefully against a laboratory potentiometer. The critical potential was determined by the intersection of the plots of ion current against voltage, before and after reaching the critical potential.

The mean value for several determinations upon the mercury standard was 15.1 volts. A correction of -4.7 volts was accordingly applied to the observed critical ionization potentials for the individual uranium fluoride ions. The critical ionization potentials are shown in the table:

Ion	Critical Ionization Potential	
	Spectrometer	Triode
UF_5^+	15.5 v	15.9 v
UF_4^+	20.1 v	-----
UF_3^+	23.5 v	-----
UF_2^+	29.9 v	-----
UF_1^+	37.9 v	-----
U^+	50.3 v	-----
HF	-----	5.4

These data may be regarded as giving a correct representation of the order of magnitude, but a probable error range of from 5% for the UF_5^+ ion to 15% for the U^+ appears likely because of the wide departure of potentials from that of the reference gas.

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* Bleakney, W., Phys. Rev. 35:139 (1930).

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